MATLAB EXPO 2016
The Rise of Engineering-Driven Analytics

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MATLAB Products
The Rise of Engineering-Driven Analytics
The Rise of Engineering-Driven Analytics
Analytics are now pervasive

Apply robust, statistically-motivated methods to data produced from complex systems to understand what has happened, predict what will happen, and suggest decisions or actions.
Analytics in e-commerce

Use Image Processing to add image data to the model, improving performance

Improvised Predictive Model

Offer to Customer

Engineering Data
- Images
- Social profile
- Geolocation
- Keystroke logs
- Transactions

Business Data
Consider the **Data** in Data Analytics

**Engineering Data**
- Video
- Audio
- Images
- Sensor

**Business Data**
- Social profile
- Geolocation
- Keystroke logs
- Transactions

**Level of Industry / User Adoption**

*Using now*

Source: Gartner Big Data Industry Insights, March 2016
Consider the **Data** in Data Analytics

![Diagram showing level of industry/user adoption for different types of data.](image)

**Engineering Data**
- Video
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**Business Data**
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**Level of Industry / User Adoption**

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The Rise of Engineering-Driven Analytics
Architecture of an analytics system

- Data from instruments and connected systems
- Analytics and Machine Learning
- Data from business systems
Architecture of an analytics system

Data from instruments and connected systems

Data from business systems

MATLAB & Simulink Integrates in Embedded Systems and Enterprise IT Workflows

Predictive Model deployed in smart and embedded systems

Predictive Model deployed on cloud and business systems
25% cost reduction
Example – BuildingIQ
Adaptive building energy management
Optimizing Energy Costs and Consumption at Building IQ

Predictive Model deployed on cloud with client system and real-time data feeds

DATA - Billions of data points: Physics, energy costs, power, internal temperatures, ambient temperatures, ambient humidity, building operation schedule, comfort bounds, etc.

Analytics and Machine Learning plus system identification, control theory & more

MATLAB Toolboxes Just Work – and work together!

Current energy costs & demand

Weather Feeds
We could rapidly translate our prototypes into production algorithms that deal reliably with real-world noise and uncertainty.

Borislav Savkovic, BuildingIQ

Why MATLAB?

- Robust numerical algorithms
- Extensive visualization and analytics tools
- Industry-robust and **reliable mathematical optimization** routines
- Good object-oriented framework
- Ability to interface with Java (for backend work)
- Running MATLAB in the cloud in **production**
- Unit-testing framework

MATLAB Impeccable Numerics for Trusted Results
Example – Scania

Automatic emergency braking using sensor fusion and analytics
50 km/h - sudden brake
Using Model-Based Design to build and deploy the analytics in an embedded control system.

MATLAB Integrates Analytics and Model-Based Design.
Implementing Sensor Fusion at Scania

Vehicle logs of video and radar data

Predictive Model deployed on vehicle

Machine learning to develop fusion algorithms for situation detection
The Rise of Engineering-Driven Analytics

- Automotive
- Off-highway vehicles
- Aeronautics
- Retail
- Finance
- Healthcare management
- Internet
- Industrial Automation
- Oil & Gas
- Medical Devices
- Clean Energy
Predictive Maintenance for polymer-based production machines

Sensor Data (~1 minute)
10-100 sensors/machine

Quality State (~40 minutes)

Classification using Statistics, Machine Learning, and Neural Networks

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Deployment – a MATLAB App used by machine operators

M153

M157

State NOT OK

State OK
The need for data scientists

- Domain expertise
- Coding and integration skills
- Statistical and mathematical knowledge
What they say

- Expand university programs
- Train existing analysts
TSMC Student Contest
use process control data to improve semiconductor yields

- 21 teams competed
- Wafer Big Data in Hadoop
- MATLAB used by winning team and 2nd place team
IoT open data platform for students and makers

Built-in MATLAB analysis

Simulink support via Raspberry Pi
MATLAB lets you be your own data scientist

MATLAB is Designed and Documented to be Easy for Engineers and Scientists to Use

- Domain expertise
- Statistical and mathematical knowledge
- Coding and integration skills
**Limited users, scope, & technology**

**Big Data**
- Engineering
- Business
- Transactional
- Native support for engineering data
- Database interfaces
- Streaming

**Compute Power**
- Desktop
- Multicore, GPU
- Clusters
- Cloud computing
- Hadoop with Spark

**Machine Learning**
- Neural Networks
- Classification
- Clustering
- Regression
- ...and much more...

**Pervasive users, scope, & technology**

**In MATLAB**

**NEW for MATLAB**
- Audio System Toolbox R2016a
- Vision HDL Toolbox R2015a

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In MATLAB
- Native support for engineering data
- Database interfaces
- Streaming
- Datastore
  - text, image, video, Excel files
  - Timetable, string, and tall arrays 2016b
In MATLAB

Native support for engineering data
Database interfaces
Streaming
Datastore
text, image, video, Excel files
Timetable, string, and tall arrays 2016b

- Engineering
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Desktop
Multicore, GPU
Clusters
Cloud computing
Hadoop with Spark

Multicore & GPU
MATLAB Distributed Computing Server and EC2 Support
Hadoop with Spark support R2016b
MATLAB Production Server

MATLAB is fast:
- heavily optimized libraries
- JIT compiled
- takes advantage of the compute power you have
Big Data

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- MATLAB Production Server

- Statistics and Machine Learning Toolbox
- Classification Learner App R2015a
- Neural Network Toolbox
- CNNs for Deep learning R2016a
- Machine learning with code generation

Limited users, scope, & technology

Pervasive users, scope, & technology
Classification Learner App
in Statistics and Machine Learning Toolbox
camera = webcam;
img = snapshot(camera);
net = alexnet;
label = classify(net, img)
Example – **cellscope**

First consumer otoscope in a mobile device using machine learning and computer vision
The Rise of Engineering-Driven Analytics

Be your own Data Scientist!